# Table of Content

**SECTION 1 BLOWING ROOM PROCESS** ................................. 2  
1.1 Purpose of Blowing Room Process ........................................... 2  
1.2 Bale Opening ........................................................................ 2  
1.3 Cleaning ............................................................................... 2  
1.4 Blending ............................................................................. 3  
1.5 Foreign Substance Detector .................................................... 3  

**SECTION 2 CARDING PROCESS** ........................................... 5  

**SECTION 3 DRAWING PROCESS** ........................................... 6  
3.1 Purpose of Drawing ............................................................... 6  
3.2 Definition of Draft ............................................................... 6  

**SECTION 4 COMBING PROCESS** ........................................... 7  
4.1 Purpose of Combing ............................................................. 7  
4.2 Combing Preparation ........................................................... 7  
4.3 Combing Mechanism ............................................................ 7  

**SECTION 5 ROVING PROCESS** ............................................. 8  
5.1 Function of Roving Process .................................................. 8  
5.2 Drafting System ................................................................... 8  
5.3 Roving Twist ....................................................................... 9  
5.4 Bobbin Building .................................................................. 9  

**SECTION 6 SPINNING PROCESS** ......................................... 10  
6.1 Purpose of Spinning .............................................................. 10  
6.2 Process Flow Chart for Various Common Spinning Systems .................................................................................................................. 10  
6.3 Open-End Spinning ............................................................. 11  
6.4 AIR-JET SPINNING .............................................................. 13  

**SECTION 7 WINDING PROCESS** .......................................... 15  
7.1 Purpose of Winding .............................................................. 15  
7.2 Drum ............................................................................... 16  

**SECTION 8 TWISTING PROCESS** ....................................... 17  
8.1 Up Twister ........................................................................ 17  
8.2 Ring Twister ...................................................................... 17  
8.3 Two-for-One Twisting ......................................................... 17  

**SECTION 9 WOOL SPINNING PROCESS** ................................ 19  
9.1 Worsted System ................................................................ 19  
9.2 Woollen System ................................................................. 20  

**SECTION 10 TEXTURING** ...................................................... 22  
10.1 Purpose of Texturing ......................................................... 22  
10.2 False Twist Method ............................................................ 22  
10.3 Edge-Crimped Yarns .......................................................... 22  
10.4 Stuffer-Box Crimping ........................................................ 22  
10.5 Air-Textured Yarns .............................................................. 24  
10.6 Knit-De-Knit Method ........................................................ 25  
10.7 Gear Crimping .................................................................. 25  
10.8 Twist-Textured Yarns .......................................................... 26  

**REVISIO**N HISTORY ............................................................. 27
SECTION 1 BLOWING ROOM PROCESS

1.1 Purpose of Blowing Room Process

Opening and picking of cotton necessitates several steps to get the cotton from a tightly packed bale containing trash and other foreign matter, and ready for the carding operation. These steps include separating the cotton into particles small enough to facilitate cleaning and reforming the tufts into a sheet suitable for carding. Since the feeding of cotton is done from the original bales, this operation includes the blending or mixing of the various fiber properties to be contained in the final yarn and fabric. For synthetic material, the opening and beating points should be minimized to as few as possible.

1.2 Bale Opening

At the very beginning, automatic feeding of cotton is generally accomplished by the use of a circular bale picker or a continuous rectangular bale opener. This picker or opener is designed to receive the layers of cotton directly from the bale and to break these layers into small lumps. To ensure evenness in blending, usually the lay-out of the cotton bales should have the same height level. Lying bales of material on a conveyor belt is a special idea on today’s continuous bale opener.

![Figure 1.1 Bale Opener (Rieter UNIfloc A11)](image)

1.3 Cleaning

The purpose of the cleaning machines is the opening of larger particles of cotton and the removal of large motes, pieces of trash, and other heavy foreign matter in the cotton. The main action of cleaning machines is to beat the cotton which tends to be carried upward. In addition, any air motion is upward. This air motion is quite important; it sets up a definite suction through the machines. During the beating about of
the opening action, the cotton is repeatedly thrown against the inner casing, and the heavy particles, which are exposed, are thrown off, passed through the openings, and settled outside the beater chamber.

### 1.4 Blending

Nowadays, blending or mixing of cottons is accomplished by the use of a multi-blender. These machines have 6 to 8 rooms, and the more rooms the machine has, the better the blending results. There are two openings in each room, one at the top and one at the bottom. Cottons are deposited into each room in a sequential order through the top opening and dropped onto a conveyor belt from the bottom opening. The conveyor belt carries tufts of cotton from different rooms towards a stripping roller which further beats cottons into fine and small particles.

![Figure 1.2 Bale Opener (Truetzschler Multimixer MPM 6)](image)

1. Feed funnel
2. Closing flap
3. Mixing chamber
4. Feed duct
5. Light barrier
6. Perforated plate
7. Delivery rolls
8. Opening rolls
9. Blending duct
10. Material suction funnel

### 1.5 Foreign Substance Detector

Spinning mill problems associated with foreign matter in cotton have increased during the past years. In developing countries with their low labor costs, it is not uncommon to employ up to 100 persons per shift for contaminant screening. However, in high labor cost regions, automated systems are the only sensible alternative. For example, magnets located after the automatic bale opener or cleaner would pick up any tramp iron particles which might be picked up with the cotton at the feeding bale. Newly developed foreign substance detectors are also recommended to be arranged in the blowing room for high quality bleached white or raw white yarn.
Figure 1.3 Foreign Substance Detector (Securomat)
SECTION 2 CARDING PROCESS

The fibers opened in the blow room will be fed to the card for further cleaning and fiber separation. The principle of carding is to separate cotton fibers into their individual elements, thereby exposing and removing the bits of leaf, trash, and other foreign matter enclosed by the unopened fiber aggregates, and form the cleaned, disentangled fibers into slivers to feed the next process.

In the entry part of a carding machine, the licker-in (a cylinder covered with metallic wires,) strikes against the fringe of fiber as it is fed forward, tears away tufts of fibers, and carries them forward to the main cylinder. The card cylinder is the heart of the card. All other parts are built around and adjusted to it. The doffer is a small cylinder made and clothed like the main cylinder. Metallic clothing is used for the doffer. The function of the doffer is to collect the cotton from the cylinder in a uniform fleece, which is delicately removed to form the card web.

The transfer of fiber from cylinder to the slow doffer is accomplished by a stripping action, after which the film of cotton is stripped from the doffer as a web by the action of a stripper roll, and is drawn forward and gathered through a funnel-shaped opening, the trumpet plate, which shapes the web into a round sliver.

Figure 2.1 Twin Cylinder Carding Machine (Crosrol CST)
SECTION 3 DRAWING PROCESS

3.1 Purpose of Drawing

The purposes of drawing are to improve the uniformity of the slivers and to straighten the fibers in the slivers. The improvement in uniformity is due to the doubling and drafting of six to ten slivers into one. The straightening of the fibers is accomplished by drawing fibers by each other. The straightening is important because it arranges the fibers more parallel to each other and to the direction of the strand. When the fibers are well straightened, the arrangement helps in producing uniform, strong and smooth yarn.

3.2 Definition of Draft

Draft is the measure of the amount the sliver is reduced as it passes through the machine. The draft on draw frames may be determined by the ratio of weights fed and delivered, and the usual draft ranges from 5.5 to 10. It is measured by the reduction in the weight per yard of the processed slivers.

The draft takes place in roller drafting zones. The fibers are held firmly between the top roller and bottom roll. If the rolls are rotating and the circumference speed increases from roller pair to roller pair in the direction of the fiber flow, the fibers are pulled apart or drafted.

Figure 3.1 Drawing Machine with Auto-levelling System
SECTION 4 COMBING PROCESS

4.1 Purpose of Combing

The fundamental purpose of combing is to remove the shorter fibers and also the trash and nep which would otherwise impair the strength and appearance of the yarn. In separating short from long fibers, the long fibers are straightened to a considerable degree and made parallel to each other. Combing is used in the production of high quality fabrics, those for which fine, clean, strong yarns of lustrous appearance are required.

4.2 Combing Preparation

As card sliver is used to feed the comb, it is necessary to arrange the carded sliver in the form of a lap. The conventional way to prepare cotton for the combing process consists of passing the carded slivers through firstly a sliver lap machine and then a ribbon lap machine. An alternative and more efficient way is passing the carded sliver through one drawing process followed by a lap former for the purpose of packing the drawing slivers into a comber lap.

4.3 Combing Mechanism

Generally, a combing machine has eight identical combing heads, each of which carries a lap which is fed forward by a pair of fluted feed rollers. The slivers produced by the individual heads are joined together on a table in two groups of four, and processed through a drafting system to form two slivers which are then coiled into separate cans.

Figure 4.1 Combing Machine with Feed Frame (SERVOlap E 6/4 - L)
SECTION 5 ROVING PROCESS

5.1 Function of Roving Process

The purpose of the roving operation is to reduce the sliver to a suitable size for spinning. A roving machine reduces the slivers by roller drawing, twists them slightly as needed, and winds the product accurately on a specially form of bobbin for further use in spinning.

5.2 Drafting System

The simplest drafting system used on the roving frames is the three roll drafting system in which three lines of rolls are running at increasing speeds. The drawing rolls of a roving machine have to be adjusted according to the staple of the material, the bulk in process, and the condition and character of the material.

5.2.1 In -Feed Material

The counts of feed slivers normally used in everyday practice today are between approximately 3.4 and 4.6 ktex (Nm 0.30 - Nm 0.22). Sliver counts in this range provide for ideal speed frame drafting. The maximum feed sliver count may not exceed 6 ktex (Nm 0.17).

5.2.2 Total Draft

The amount of total draft on a four- or three-roller double apron drafting system is between 5 and 18, a range of 5-12 providing best results. Drafts greater than 12 are seldom employed as the total draft on a ring frame should be as high as possible, for yarn quality reasons. For drafts lower than 5, a speed frame should not be used, as faulty drafting may occur at such low total draft rates.

5.2.3 Rear Draft

The task of the rear draft is to tension the fiber material in the rear zone and draw it parallel. Rear drafts of between 1.12 and 1.18 are normally used in practice.

5.2.4 Roller Loading

In speed frames, the pressure stage to be set on the weighting elements is determined by the type of fiber, the fibrous mass and the amount of total draft. Basically, the greater the fibrous mass, the higher the loading pressure. For low total drafts, comparatively higher loading pressures have proved their worth.

5.2.5 Top Roller Cots Grinding

Cot grinding intervals depend on the quality of the cot; the type of fibrous material; finishing agents or other additives; climatic conditions; the weighting pressure of the top roller and the top roller running time.
5.2.6 Roving Guide and Condensers

It is a general practice to use roving guides and condensers on roving frames to guide flank fibers back into the fiber strand. The task of the condensers is to evenly fold flank fibers back into the fiber material. The condenser apertures should be neither too narrow nor too wide in order to avoid possible faults in the drafting process.

By condensing the fiber, a reduction in the spinning delta is achieved, thus improving the incorporation of the fibers into the roving. This results in the important advantages of reduced number of thread breakages (improved process reliability); increased efficiency; greater package density; and reduced fly generation.

5.3 Roving Twist

The purpose of roving twist is to give the relative fine strand of fibers sufficient strength to withstand the stresses of winding at the roving frame and subsequent unwinding in the spinning frame. It is a traditional procedure in the mill to keep the roving twist as low as possible so as to maintain maximum production of roving and facilitate ring frame drafting.

Twisting is accomplished by the use of a flyer which is carried on the upper end of a vertical spindle. The flyer is made of steel in the form of an inverted U. There is a small guide, the presser, attached to the lower end of the hollow leg. The presser may swing in and out, with the hollow leg as a centre.

The fibers delivered by the front rolls of a roving frame are in the form of a thin ribbon. This ribbon is carried forward and downward to the top of the flyer. It is threaded through the top of the flyer, down through the hollow tube, wound around the presser arm and through the presser eye onto the bobbin. Each time the flyer makes one complete revolution, one twist is put into the roving. The amount of twist required by any roving should be judged carefully; as twist is used for strength, there should be enough so that the ends will not break in the next processing. However, if too much twist is used, the roving will not draw well in the ring spinning processing.

5.4 Bobbin Building

Bobbin winding is the operation of drawing the roving from the front roller, through the flyer onto the bobbin. The actual winding is accomplished by having the bobbin revolve faster than the flyer. As the diameter is increased, it is necessary to decrease the revolution speed to keep the winding speed (surface speed of the bobbin) equal to the delivery from the front rollers.

As the roving is guided by the presser of the flyer which does not rise and fall, lay is accomplished by traversing the bobbins slowly upward and downward as the roving is being wound.
SECTION 6 SPINNING PROCESS

6.1 Purpose of Spinning

In spun yarn production, spinning is the final stage of processing that produces a continuous twisted strand of fibers which has received its final attenuation.

6.2 Process Flow Chart for Various Common Spinning Systems

<table>
<thead>
<tr>
<th>Ring(Combed)</th>
<th>Ring(Carded)</th>
<th>Rotor</th>
<th>Air - jet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blowing Room</td>
<td>Blowing Room</td>
<td>Blowing Room</td>
<td>Blowing Room</td>
</tr>
<tr>
<td>Carding</td>
<td>Carding</td>
<td>Carding</td>
<td>Carding</td>
</tr>
<tr>
<td>Prep Draw</td>
<td>1st passage Drawing</td>
<td>Drawing</td>
<td>Prep Draw</td>
</tr>
<tr>
<td>Lap Winding</td>
<td>2nd passage drawing</td>
<td>Lap Winding</td>
<td>Combing</td>
</tr>
<tr>
<td>Combing</td>
<td>1st passage drawing</td>
<td>1st passage drawing</td>
<td></td>
</tr>
<tr>
<td>2nd passage drawing</td>
<td>2nd passage drawing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Roving</td>
<td>Roving</td>
<td>O.E. Spinning</td>
<td>Jet Spinning</td>
</tr>
<tr>
<td>Ring Spinning</td>
<td>Ring Spinning</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Winding</td>
<td>Winding</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 6.1 Process Flow Chart for Various Common Spinning Systems

6.2.1 Drafting system

The standard drafting equipment on spinning frames consists of three pairs of steel rolls, and for most systems, aprons are mounted with the middle rolls. The top rolls are held in contact with the bottom rolls by pressures of the weighting arms applied on the roll neck between the two bosses. The top rolls are usually covered with synthetic material which provides a better fiber control. The speed ratio of each pair of rolls is so adjusted that the fibers are delivered from a slowly moving pair of rolls towards a rapidly moving pair of rolls. The distance between the front and the middle rolls, and the middle and the back rolls are adjustable to accommodate different fiber lengths.
6.2.2 Twisting

Twisting is done by the spindle and traveler. Twist is inserted by threading the yarn through the traveller and the other end of the yarn revolves at high spindle speed on the circular track of the ring. As the twist is inserted, it progresses upward, through the thread guide, to the front roll and so gives the fiber ribbon enough strength to withstand the running tension.

6.2.3 Bobbin Building

Lay refers to the spacing of the coils of yarn wound in any one layer on the bobbin. Spinning lay is similar to roving lay, but it is not practical to arrange yarns as closely as roving. The number of coils of yarn which may be arranged side by side on a bobbin depends on the yarn diameter (varies with the yarn count, the type of material and the amount of twist).

6.3 Open-End Spinning

The heart of the open-end process is a rotor, wherein fibers can be collected and then drawn off as a yarn. For short staple spinning, most rotors are 28 to 56 millimeters in diameter. In open-end spinning, the rotor rotation provides the twisting force.
The basic difference between ring-spun yarns and open-end spun yarns is the way in which they are formed. The former produces yarn by inserting twist into a continuous ribbon-like strand of cohesive fibers delivered by the front rolls, while the latter forms yarn from individual fibers directly, by collecting them from the inside surface of a rotor by twist forces.

![Figure 6.4 Rotor of an Open End Spinning System](image)

Open-end spinning is ideally suited for spinning of short fibers. A ring-frame drafting system has a minimum staple length requirement for proper fiber control to produce a quality yarn. Once control is lost, the resultant yarn spins inefficiently, and the yarn appearance is poor. Since open-end yarn is formed by
twist attraction of the rapidly rotating open-end, fiber control is no problem, and therefore short staple fiber can be spun into more even and, in some cases, stronger yarn.

![Ring Spun](image)

**Figure 6.6 Illustration of the Surface Characteristic Differences of Ring and Open End Yarns**

### 6.4 AIR-JET SPINNING

A sliver is drafted to a predetermined size in the draft zone and then passes into a nozzle box. Within the nozzle box, air at high pressure is released from jets set in the walls. The direction of the air current swirling in the first nozzle is opposite to that swirling in the second nozzle. Fibers protruding from the main fiber strand are made to wind around the strand by the swirling air currents in the first nozzle, giving the strand cohesion and strength. The second nozzle enhances the cohesion of the strand to give the yarn its final strength. The delivery speed of air-jet spinning can up to 400 meters per minute in the yarn count range from 5.5 - 30 tex. This rate of productivity is as high as 10 times that of ring spinning and twice that of open-end spinning.

Since its introduction in the early 1980’s, air-jet spinning and its development have been directed primarily towards synthetic and cotton/synthetic blend spinning. Unlike other spinning methods, fine count air-jet yarns run at high production speeds, as they are twist dependent. The primary draw back of air-jet cotton yarns is their low tenacity compared to ring yarn.
Figure 6.7 Muratec 851 MVS Air-jet Spinning Machine

Figure 6.8 Air-jet Spinning Machine Nozzle Zone
SECTION 7 WINDING PROCESS

7.1 Purpose of Winding

The need for winding arises from the fact that yarn content on spinning cops is of a discontinuous nature which requires preparation of bigger packages suitable for more economical running in the subsequent processes, namely warping, sizing, weaving and knitting. The other pre-requisite of the process is the clearing action that has taken place in winding. The removal of defects in winding not only improves the quality of the yarn, but also tends to increase production in the operations that follow. An end that breaks during warping or weaving stops the entire operation, whereas in winding only one winding position is affected.

**Figure 7.1 Types of Knot**

In most winding machines, the spinning bobbins are mounted in an approximately vertical position below the winding unit. The yarn is withdrawn over the top end of the spinning bobbin, moves through yarn guides, tensioning devices, and slub catchers before winding onto the core. The tensioning device is set to establish the correct density or firmness of the package, while the slub catchers serve to catch and break out slubs, large knots, and wild or kinky yarn.

**Figure 7.2 Spinning Bobbin Shape**

\[
\begin{align*}
d_1 & \geq d_2 \\
d_2 & = d_1 + 6 \text{ mm} \\
d_3 & = 14 - 32 \text{ mm} \\
a & = 12 \text{ mm (minimum)} \\
b & = 10 \text{ mm (minimum)} \\
L & = 200 \text{ mm} - 340 \text{ mm} \\
D & = 34 \text{ mm} - 75 \text{ mm} \\
H & = 1.2 \times D
\end{align*}
\]
7.2 Drum

A larger number of drum winds is better to prevent ribbon winding. However, depending on the yarn count, the shape of the wound package may sometimes be deformed.

Figure 7.3 Number of Winds

Figure 7.4 Schematic Overview of the Autotense Yarn Tension Control
SECTION 8 TWISTING PROCESS

Twisting is the last stage after ring spinning. Though the yarn quality has already been determined during ring spinning, processing, twisting parameters and mechanisms have their influence while producing twisted or ply yarn, such as luster, strength, extension and balance. There are different twisting systems; the ring twister, the up-twister and the two-for-one twister. The latest development is the Tritec Twister.

8.1 Up Twister

The yarn bobbin (feed package) is put on the spindle, which is rotated with the bobbin at high speed to insert the twist into yarn. Twisted yarn is then wound slowly on a cylinder or tube type of take-up bobbin.

8.2 Ring Twister

Yarn from feed package is withdrawn slowly by the pair of feed rollers and goes through the yarn guide and wind on a ring spindle. Twists are inserted by the ring and traveler system. There are two types of twist insertion kits, ring and flyer.

<table>
<thead>
<tr>
<th>Double Twister</th>
<th>Ring Twister</th>
<th>Uptwister</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Diagram" /></td>
<td><img src="image2.png" alt="Diagram" /></td>
<td><img src="image3.png" alt="Diagram" /></td>
</tr>
</tbody>
</table>

Figure 8.1 Ring Twister and Uptwister

8.3 Two-for-One Twisting

With the Two-for-One twisting system, the thread receives two turns with one revolution of the spindle. To obtain this Two-for-One effect, the yarn is unwound from the stationary feed package, passes through the hollow axle, and the yarn tension device, enters the rotating upper part of the spindle and leaves it through the opening of the spindle rotor.
Figure 8.2 Two-for-One Twisting System
SECTION 9 WOOL SPINNING PROCESS

Two main systems are used to process wool from fiber into fabric. **Worsted** system uses **fine long clean** wool to produce high quality suit and fashion fabrics, while **woollen** system uses **coarser, short** wool to produce upholstery, bulky knitwear, blankets and tweeds.

9.1 Worsted System

9.1.1 The worsted spinning process flow is as follows

Raw wool ==> Scouring (opening & cleaning) ==> Drying (Scoured wool) ==> Oiling
Carding ==> Preparatory gilling ==> Combing ==> Backwashing ==> Finisher gilling (Wool top) ==> Drawing (Roving) ==> Spinning (worsted yarn)

9.1.2 Scouring

This is another part of the opening, cleaning, and mixing process. Wool fleece contains grease, suint (sheep perspiration, or sweat), sand, dirt and vegetable matter, all of which have to be removed. In order to prevent the yellowing of wool in alkaline conditions, non-ionic detergents in a neutral solution at a higher temperature (60 to 70°C) can be used.

The scouring machine contains a series of scouring bowls by a hopper feeder that feeds a uniform flow of wool at a rate that will provide uniform and adequate treatment. Felting (the excessive shrinkage of wool due to the interlocking of wool fibers) can occur when wool is agitated, and so careful control of the rate of agitation is essential. Fine wool contains more grease, and so requires more treatment.

9.1.3 Drying

Wool is dried after scouring, in preparation for carding. It should not be dried excessively, since this may impair the wool’s elasticity and formation of neps.

9.1.4 Oiling

In order to minimize dust in the card room and to lubricate the fiber, about 0.5% by weight of oil is applied to it.

9.1.5 Carding

This process is for further opening, cleaning and mixing and for sliver formation. During carding, fibers are opened, and small traces of wool grease and dust residue from scouring are removed.

9.1.6 Backwashing

This process is for cleaning and mixing. Large numbers of slivers are passed side by side through a wash bowl containing soap or detergent solution, then through a second one for rinsing. They are finally dried in a drier. In a dry-combing process backwashing straightens the fiber and removes the crimp from it. In an
oil-combing process, oil is added after drying so that the slivers are spread uniformly over the feed roller of the combing machine.

9.1.7 Combing

This process is for opening, cleaning and mixing the fibers, to make them parallel and to assist in sliver formation. The wool leaves the machine with the fibers well aligned and parallel.

9.1.8 Gilling

This part of the process takes place both before and after combing. Before combing, the purpose of gilling is to reduce fiber entanglement, minimize the development of unevenness in the slivers and also straighten the fibers. After combing, the purpose of gilling is to improve the evenness of the combed sliver; to produce what is known as a top with an acceptable moisture content and linear density; to blend the output of a number of combs; and to package the top sliver in a suitable form for storage, handling and transport.

9.1.9 Drawing

The drafting zone of this system is longer than for other yarns because of the longer fiber length required for worsted yarn.

9.1.10 Spinning

The system consists of a drafting zone with two pairs of rollers, the delivery rollers and the drafting rollers. In between, there are two pairs of additional rollers, the carrier rollers and the tension rollers, together with a flume (a narrow funnel-shaped guide). The top carrier roller enables twistless rovings to be drafted and is removed when twisted rovings are processed.

9.2 Woollen System

9.2.1 Woollen spinning process flow:-

Raw wool ==> Scouring ==> Carbonizing ==> Dyeing (Optional) ==> Blending and Oiling ==> Carding ==> Condensing (Slubbing) ==> Spinning (Woollen yarn)

9.2.2 Scouring and drying

This is the same as for the worsted process.

9.2.3 Carbonizing

Carbonizing uses acid to turn buffs and grass seed into carbon for removal.

9.2.4 Dyeing

The dried wool is dyed in lots or batches, to a number of shades. The different colored wools are combined with fibers from other sources.
9.2.5 Blending

The material is blended in large circular bins in which it is distributed by a rotating spreader. It is then passed through an opening machine and the whole operation may be repeated to improve the blending.

9.2.6 Oiling

At the end of the blending process, oil is applied to make cleaning easier and to prevent dirt from entering the card.

9.2.7 Carding

The carding machine straightens and attenuates the wool fibers. The uniformity of the yarn depends upon carding process. There are two sections, called the breaker and the finisher. The blend is fed into the machine by a weighing hopper, whose function is to feed equal weights of material to the card at equal intervals of time to ensure uniformity in linear density. The condenser at the delivery end divides the carded web into strips which are rubbed by leather to form slubbings or rovings. Each slubbing is wound onto a separate package called a spool.

9.2.8 Spinning

The spinning system, similar to the ring frame of cotton spinning, consists of feed rollers and delivery rollers. A false twister is located close to the delivery roller, and twists in the opposite direction to the spinning.
SECTION 10 TEXTURING

10.1 Purpose of Texturing

The purpose of texturing is to introduce permanent waviness (crimp), loops, coils, and wrinkles and thereby to modify the geometry of the constituent filaments. Textured yarns may be classified into three major groups: stretch yarns, modified stretch yarns or set yarns and bulk yarns.

Stretch yarns are characterized by their high extensibility and good recovery, but possess moderate bulk in comparison with the other two classes of textured yarns. They are produced mainly by the false-twist and by the edge-crimping processes.

Modified stretch yarns may be defined as those with characteristics intermediate between stretch and bulk yarns. Overfeeding may modify stretch yarns. They may be first soft wound in packages and then heat set or stabilized either in an autoclave in steam or during the dyeing process. These yarns are generally used in knitted fabrics.

Bulk yarns are characterized by their high bulk with moderate stretch and generally possess adequate recovery characteristics. They are mostly used in carpets, upholstery, and garments requiring warmth and comfort characteristics. Bulked yarns are produced by air texturing, stuffer box, knit-de-knit, gear crimping, twist texturing, and various other types of crimp texturing processes.

10.2 False Twist Method

This is the most versatile and most widely used method of producing stretch-type textured yarns. The false-twist method combines all three stages, namely, twisting, heat setting, and untwisting in one continuous operation. The yarn is drawn from the supply package, fed at controlled tension over the heater and through the false-twist spindle, and finally wound on a package. The twist in the yarn is set when it is between the input feed roll and the false-twist spindle, by heating and cooling before it leaves the false-twist spindle.

10.3 Edge-Crimped Yarns

Stretch and modified stretch yarns can also be produced by a process known as “edge crimping”. Thermoplastic yarns are edge crimped by a continuous process in which a yarn is tensioned, stretched, heated, bent, and drawn around an edge, followed by shrinking and cooling steps.

Fabrics made from these yarns have a soft, full hand, good surface texture, very good dye uniformity, moderate stretch, and excellent recovery from stretch.

10.4 Stuffer-Box Crimping

The process of texturing by the stuffer-box is based on the principle of heat setting filaments being held in a confined space in a compressed state, and then withdrawn in their crimped form. The chamber in which the filaments are stuffed is known as the “stuffer-box”. The thermoplastic feed yarn is positively fed by two
feed rollers into the heated tube stuffer-box to be. On the output side, the yarn is passed through a weighted hollow tube or slug that impedes the progress of the crimped yarn traveling up the tube,

![Figure 10.1 Line Diagram Showing the Path of a Yarn Through a False-twist Texturing Machine](image1)

![Figure 10.2 Principle of Edge Crimping](image2)

effectively causing the yarn to back up inside the stuffer-box tube. At the same time the feed rolls keep delivering fresh yarn against the backed-up aggregate in the tube. The hot stuffer-box yarns generally have
a wiry appearance, a soft feel, and high cover and bulk characteristics. These yarns also have good moisture absorption properties because of the minute spaces created between the filaments that can hold moisture.

Figure 10.3 Stuffer-box Principles Used for Producing Textured Yarns.

10.5 Air-Textured Yarns

The yarns used in air texturing generally have some initial twist. Bulk in continuous filament yarns can be produced by blowing a stream of air into a twisted yarn while it is being delivered at a higher rate than is being taken up by the winding process. The air stream creates a turbulence that causes the formation of random loops in overfed individual filaments. The yarn thus produced has an appearance like a staple yarn but possesses higher bulk, greater covering power, reduced opacity and a warmer hand compared to flat continuous-filament yarn.

Air-textured yarns generally exhibit lower tenacity and elongation to break than that of the parent continuous-filament yarn before texturing. Processing conditions such as twist, overfeed, and air pressure significantly modify the tensile behavior of air-textured yarns. Air textured yarns are used in a number of end-use applications, such as apparel, furnishings, and some industrial fabrics.
10.6 Knit-De-Knit Method

In this method, the flat yarn is first knitted, then heat set and unraveled to produce a crinkle structure, the crimp frequency and shape can be varied by varying the needle gauge on the machine and the fabric structure (plain jersey, rib, double jersey, interlock, etc.). The fabrics produced from knit-de-knit crinkle yarns have a pronounced sparkling boucle texture, excellent stretch and recovery from stretch, and full hand. These yarns are torque free and therefore do not require any subsequent heat setting.

10.7 Gear Crimping

Bulk can also be produced in a continuous filament yarn when it is passed through closely meshed gears. The gear head is heated so that the crinkle produced in the yarn is permanent. These yarns are used in a variety of end-use applications, such as ladies’ and children’s knitted outerwear, sweaters, and ladies blouses.
10.8 Twist-Textured Yarns

If two ends of yarn are twisted together around a common axis, rather than each yarn being twisted around its own axis, and the configuration is then heat set in the twisted state and finally untwisted, the yarn thus produced possesses excellent bulk. This is a very simple concept of introducing texture into thermoplastic continuous filament yarns. The yarns textured by this method have excellent dyeing uniformity, high cover, and extremely soft, smooth hand. Twisted textured yarns find uses in tricot fabrics, hosiery, and all types of knitted outerwear structures.
**REVISION HISTORY**

<table>
<thead>
<tr>
<th>Revision#</th>
<th>Description</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Initial Release</td>
<td></td>
</tr>
</tbody>
</table>